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Factors Associated with Asthma Prevalence among Racial and Ethnic Groups—United States, 2009–2010 Behavioral Risk Factor Surveillance System

Hatice S. Zahran, M.D., M.P.H.* and Cathy Bailey, M.S.

Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA, USA

Abstract

Background—Although the causes of asthma are poorly understood, multiple factors (e.g., genetic, environmental, socioeconomic, and lifestyle) have been implicated in the development and exacerbation of the disease,

Objectives—To identify the potential predictive factors of current asthma and to assess if the predictive ability of some factors differs by race and ethnicity,

Methods—We used the Centers for Disease Control and Prevention’s 2009–2010 Behavioral Risk Factor Surveillance System data to estimate asthma prevalence and to examine the potential predictive factors for asthma (sex, age, educational attainment, household income, obesity, smoking, physical activity, and health insurance) by race and ethnicity,

Results—Of the 869,519 adult respondents in the survey, 8.6% reported having asthma. Asthma prevalence for all race/ethnic group was significantly higher among adults with a household income of <\$15,000 (13.3%; adjusted prevalence ratio [aPR] of 1.9) than those with income of \$15,000–\$75,000 (6.8%). The prevalence was also higher among obese adults (11.6%; aPR = 1.5) than non-obese (7.3%), current and former smokers (10.5%; aPR = 1.2 and 8.8%; 1.2) than non-smokers (7.8%), and adults with health insurance (8.6%; aPR = 1.3) than adults without it (7.8%). However, the prevalence was lower among adults aged 65+ (7.8%; aPR = 0.7) than adults aged 18–34 (9.3%) and among adults who reported having leisure time physical activity (7.8%; aPR = 0.8) than adults who did not report it (10.7%). When examined among the racial/ethnic groups, these associations were observed among whites and blacks but not for the other four racial/ethnic groups,

Conclusions—Predictive factors for asthma vary among the racial/ethnic groups. Identifying race/ethnicity-specific modifiable environmental and host-related factors (mold, pollens, house dust mites, cockroaches, animal allergens, other pollutants, education, income, obesity, smoking, physical activity, and health insurance status) can be important in developing targeted

*Corresponding author: Hatice S. Zahran, M.D., M.P.H., Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway, NE, MS F-60 Atlanta, GA 30341, USA; Tel: + 770/488-1509; Fax: +770/488-1540; HZahran@cdc.gov.

DECLARATION OF INTEREST

The authors declare no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

interventions to reduce the health and economic impact of asthma among the disproportionately affected segments of the United States population.

Keywords

adults; asthma prevalence; current asthma; demographic characteristics; low income; predictors of asthma; race/ethnicity

Introduction

Asthma is a chronic respiratory disease with recurrent episodic symptoms (e.g., wheezing, cough, shortness of breath, and chest tightness) caused by inflammation and narrowing of small airways (1). Asthma affects nearly 8% of the US adult population. There has been a rising trend in asthma prevalence across all demographic subgroups—children, adults, males, females, whites, blacks, and Hispanics—over the past few decades (2, 3). The increased prevalence imposes a substantial health and economic burden on the individuals and the society (2-5). The estimated total cost of asthma to the United States was \$56 billion (in 2009 dollars) in 2007 (5).

The causes of asthma remain poorly understood. Multiple factors play a role in the development of asthma and the exacerbation of asthma symptoms. It is believed that genetic predisposition, exposure to environmental factors, and significant gene–environment interactions may influence development of asthma and exacerbation of the symptoms (6-11). Genetic predisposition may lead to the development of asthma and allergies (e.g., atopic dermatitis [eczema] or allergic rhinitis [hay fever]) (6, 8). However, the genotype of asthma is complex (10, 11) and a positive family history of asthma does not always predict the disease's development (9). Environmental irritants and allergens (e.g., mold, pollens, house dust mites, cockroaches, rodents, animal allergens, environmental tobacco smoking [ETS], and other air pollutants) are also important factors that may affect current asthma status differently at different times of a person's life, and reaction to them may change over time (6, 12). There is no consensus for many environmental factors on whether they cause the development of asthma or only trigger asthma symptoms (12, 13-15).

Asthma prevalence may also be associated with other host-related factors (e.g., age, sex, race, ethnicity, smoking, obesity, viral and bacterial infections, and co-morbid conditions [e.g., gastro-esophageal reflux disease [GERD], chronic sinus disease]) (16, 17). Some of these factors are modifiable (e.g., education, income, health insurance status, smoking, obesity, and co-morbid conditions) (14, 18-20, 21), while some are not (e.g., heredity, age, sex, race, and ethnicity) (8, 18, 19). Asthma disproportionately affects certain demographic groups, and the disproportionate impact has persisted over time (2-4). Current asthma prevalence is higher among women than men and among children than adults. Also, asthma prevalence is higher among blacks, American Indians or Alaska Natives (AI/AN), persons of multiple race, and lower among Asian and Hispanics than whites (2-4, 18, 19).

Previous studies show that differences in life experiences (e.g., family, social, and economic environment), lifestyle choices (smoking, obesity, leisure time physical activities), and exposure to adverse indoor and outdoor environment factors (e.g., mold, pollens, house dust

mites, cockroaches, rodents, animal allergens, ETS, and other air pollutants) may account for some of the racial and ethnic differences in asthma prevalence (8, 12, 14, 18, 20). Even though previous studies have identified the potential predictors of asthma, specific information about the predictive factors among racial and ethnic groups has been limited. These study findings were limited to either a few major racial/ethnic groups (e.g., white vs. non-white or whites vs. blacks, Hispanics, and other race) or predictive factors were examined by controlling for the effects of race/ethnicity. The aim of the present study is to assess if the predictive ability of some factors differs by race and ethnicity among US adults. To our knowledge, this is the first population-based study to assess potential predictors of asthma for each of the six racial and ethnic groups.

Methods

We analyzed data from the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) for 2009 and 2010. BRFSS is a state-based, random-digit-dialed telephone survey of the non-institutionalized US civilian population aged 18 years in all 50 states, the District of Columbia (DC), Puerto Rico, the US Virgin Islands, and Guam. We limited our study to respondents from 50 states and the DC. We combined 2 years of survey data to provide more stable estimates for relatively small racial/ethnic groups. A total of 869,519 respondents participated in the 2009 and 2010 survey, and the two survey years had median response rates of 52.5% and 54.6%, respectively. BRFSS includes standard questions and collects self-reported responses on key health-related behaviors, demographic characteristics, and disease status, including asthma. The data include sample weights to adjust for the unequal probability of selection, the disproportionate selection of population subgroups relative to the state's population distribution, or any instance of non-response. Consistent with previous CDC publications, respondents were considered to have current asthma if they answered "yes" to both questions related to asthma on the survey. The first question was, "Have you ever been told by a doctor, nurse, or other health professional that you had asthma?" The second question was, "Do you still have asthma?" (2, 3).

We used SAS-callable SUDAAN (version 10.0.0, RTI International, NC) to account for the complex sampling design of the BRFSS, and we used sample weights to produce estimates that were generalizable to the US population. In addition to calculating the descriptive statistics, we used χ^2 tests and multivariate logistic regression to test for group differences and association between variables of interest. Our initial analyses indicated a statistically significant interaction between race/ethnicity and six of the eight selected predictive factors for asthma prevalence (sex: the adjusted Wald F-statistics[df:5] = 2.24, $p = .047$; age: F[20] = 2.79, $p = .000$; education level: F[10] = 1.90, $p = .040$; annual household income: F[25] = 2.89, $p = .000$; leisure time physical activity: F[5] = 2.65, $p = .021$; and health insurance: F[5] = 4.27, $p = .000$). Therefore, we used multivariate regression analyses stratified by racial/ethnic categories to obtain race/ethnicity-specific estimates. We also repeated analyses for adults of all racial/ethnic groups. For the overall study population and for each racial/ethnic group, we calculated weighted percent estimates, adjusted prevalence ratios (aPR) (predicted marginal risk ratio), and 95% confidence intervals (CI). All prevalence ratios were adjusted (aPR) for sex, age, education, annual household income, body mass index,

smoking, physical activity, and health insurance. We did not find any multi-collinearity between independent variables (all tolerance estimates were 0.79; given that tolerance estimate below 0.40 is a concern) (22). Results were considered significantly different if 95% confidence intervals (CIs) did not overlap or if statistical testing at $p < .05$ was applicable.

Results

Of the 869,519 adult respondents, 51.3% were female, 69.2% were white, 10.4% had less than \$15,000 household income, 27.6% were obese, 17.6% were smokers, and 8.6% reported having asthma.

Adults of All Racial/Ethnic Groups

Overall asthma prevalence was significantly higher among females (10.5%; aPR of 1.6) than males (6.4%), adults with some college education (9.3%; aPR = 1.1) than adults with 4 years or more college education (7.3%), adults with low income (household income of < \$15,000) (13.3%; PR = 1.9) than adults with income of \$75,000 (6.8%), obese adults (11.6%; aPR = 1.5) than non-obese (7.3%), current and former smokers (10.5%; aPR = 1.2 and 8.8%; 1.2, respectively) than non-smokers (7.8%), and adults with health insurance (8.6%; aPR = 1.3) than those without health insurance (7.8%). The prevalence was lower among adults aged 65+ (7.8%; aPR = 0.7) than adults aged 18–34 (9.3%) and adults reported having leisure time physical activity (7.8%; aPR = 0.8) than adults who did not report. (10.7%) (Table 1).

Whites, Non-Hispanic

The asthma prevalence for whites was 8.6% (8.5–8.8%) (Table 1). Potential predictive factors for having asthma among whites were similar to the predictive factors among persons of all racial/ethnic groups. Asthma prevalence was significantly higher among females (10.6%; aPR = 1.6) than males (6.6%), adults with low income (16.2%; aPR = 2.1) than adults with income of \$75,000 (6.9%), obese adults (11.8%; aPR = 1.5) than non-obese adults (7.4%), current smokers (10.4%; aPR = 1.2), former smokers (8.7%; aPR = 1.1) than non-smokers (8.1%). The prevalence was lower for those aged 65+ (7.6%; PR = 0.6) than aged 18–34 (10.0%) and for those reported having leisure time physical activity (7.9%; aPR = 0.8) than those did not report it (11.2%). Although crude asthma prevalence was lower for whites with health insurance (8.5 %) than for whites without health insurance (9.4%), adjusted asthma prevalence was higher among those with health insurance (8.8%; aPR = 1.2) than those without health insurance (7.2%) (data is not shown). Education level was not associated with asthma prevalence among whites (Table 2).

Blacks, Non-Hispanic

Among non-Hispanic blacks, asthma prevalence was 10.0% (9.6–10.5%) (Table 1) and all selected predictive factors were significantly associated with having asthma (Table 2). The prevalence was significantly higher among females (12.3%; aPR = 1.6) than males (7.2%), blacks with high school (HS) degree or less education (11.2%; aPR = 1.2) than blacks with 4 years or more college education (7.9%), persons with low income (13.8%; aPR = 1.5) than persons with income of \$75,000 (7.1%), obese adults (12.6%; aPR = 1.4) than non-obese

(8.2%), current smokers (11.7%; aPR = 1.2), former smokers (10.1%; PR = 1.2) than non-smokers (9.5%), and adults with health insurance (10.1%; aPR = 1.2) than those without health insurance (9.7%). It was lower among adults aged 65+ (8.4%; aPR = 0.6) than adults aged 18–34 (11.5%) and for those who reported having leisure time physical activity (9.0%; aPR = 0.9) than adults who did not report it (12.1%) (Table 2).

Hispanic

Overall asthma prevalence was 6.7% (6.3–7.1%) among Hispanics (Table 1). Asthma prevalence was significantly higher among females (8.4%; aPR = 1.7) than males (5.0%), Hispanics with some college education (8.5%; aPR = 1.3) than Hispanics with 4 years or more college education (6.5%), persons with low income (7.7%; aPR = 1.3) than persons with income of \$75,000 (6.8%), obese adults (8.9%; aPR = 1.5) than non-obese (6.0%), current smokers (8.9%; aPR = 1.6), former smokers (7.9%; aPR = 1.4) than non-smokers (6.0%), and those with health insurance (7.9%; aPR = 1.7) than those without health insurance (4.3%). Age and leisure time physical activity were not significantly associated with asthma prevalence among Hispanics (Table 2).

American Indian/Alaska Native (AI/AN), Non-Hispanic

Among American Indians/Alaska Natives, asthma prevalence was 13.0% (11.7–14.5%) (Table 1). The prevalence was significantly higher for females (17.4%; aPR = 1.7) than males (9.5%), persons with low income (17.9%; aPR = 2.0) than persons with income of \$75,000 (7.8%), and current smokers (15.9%; aPR = 1.3) than non-smokers (10.6%). The prevalence was lower among those with leisure time physical activity (10.9%; aPR = 0.7) than AI/AN without it (18.5%). Age, education level, obesity, and health insurance status were not significantly associated with asthma prevalence among AI/AN (Table 3).

Asian/Pacific Islander, Non-Hispanic

Overall asthma prevalence was 4.8% (4.2–5.5%) (Table 1). Low income (8.0%; aPR = 1.9), obesity (9.2%; aPR = 2.1), and having health insurance (5.2%; aPR = 2.4) were significantly associated with higher asthma prevalence among non-Hispanic Asian/Pacific Islanders. On the other hand, sex, age, education level, smoking, and leisure time physical activity were not associated with asthma prevalence in this group (Table 3).

Other Race, Non-Hispanic

Within this group, asthma prevalence was 13.5% (12.5–14.5%) (Table 1). The prevalence was significantly higher among females (16.5%; aPR = 1.4) than males (10.7%), persons with low income (23.8%; aPR = 2.5) than persons with income of \$75,000 (9.0%), and obese adults (18.8%; aPR = 1.5) than non-obese (11.1%). It was lower among adults aged 65+ (10.8%; aPR = 0.6) than adults aged 18–34 (13.7%) and for those reported having leisure time physical activity (11.9%; aPR = 0.8) than those did not report it (18.2%). Education level, smoking, and health insurance status were not significantly associated with asthma prevalence for this group (Table 3).

Discussion

Multiple factors play a role in the development of asthma and the exacerbation of asthma symptoms. We examined the predictive ability of selected factors on asthma prevalence in the 2009 and 2010 BRFSS data. We found that all selected potential predictive factors were significant predictors of current asthma for the overall study population. These findings are consistent with those of previous research (6, 18, 19).

However, our findings indicate that although the direction of association was the same, the number of predictive factors associated with asthma differed substantially by race/ethnicity.

As in the overall results, all selected factors (sex, age, income, obesity, smoking, physical activity, and health insurance status) except for education attainment were significant predictors of asthma prevalence for both whites and blacks, two main groups of the study population. Educational attainment was a significant predictor of asthma prevalence for blacks but not for whites. In contrast, fewer factors were significant predictors of asthma for the other four racial/ethnic groups (Hispanics, AI/AN, Asian, and other race). These findings can partly be explained by the small sample size and partly by the racial/ethnic variability in the predictive ability of some predictive factors for asthma. The predictive ability of educational attainment differed by race and ethnicity. Asthma prevalence was higher among blacks with a HS degree or less and Hispanics with some college education, compared with corresponding adults with 4 years or more college education, but the prevalence was similar at all educational levels among whites, the group with largest sample size. Also, the prevalence was significantly higher among AI/AN females than AI/AN males, but found no such sex difference among the Asian/Pacific Islanders for which sample size was larger than that for AI/AN.

Both current and former smokers had a significantly higher asthma prevalence than non-smokers among whites, blacks, Hispanics, and AI/AN (current smokers only) but not among Asian/Pacific Islanders and those in the other race category. Asthma prevalence was significantly higher among obese adults in all racial and ethnic groups except for AI/AN. Based on our initial analyses, the interaction between race and ethnicity and obesity or smoking status was not statistically significant; therefore, any non-significant association between these factors and asthma prevalence among any racial and ethnic groups was more likely because of the small sample size.

Our findings of higher asthma prevalence among former smokers are consistent with the findings of Beane and colleagues that a greater percentage of irreversible and slowly reversible genes were down-regulated (a decrease in the number of receptors on cell surface, usually due to long-term exposure to a toxic agent) by smoking, a suggested possible mechanism for persistent changes that may explain the risk of developing tobacco-induced lung disease among former smokers in any racial/ethnic groups (14, 15). Also, because of the cross-sectional nature of the survey, we could not rule out the possibility that higher asthma prevalence among former smokers can partly be explained by more adults with asthma giving up smoking.

Despite the known underlying mechanism by which exercise initiates or worsens asthma symptoms (6) or improves asthma symptoms by reducing obesity risk (20), exercise did not reach a significance level sufficient to predict asthma prevalence for Hispanics and Asian/Pacific Islanders. This could in part be attributable to sample size or variation in confounding factors by time and by populations (21, 23). Additional studies are needed to assess the effects of exercise on the development of asthma and asthma symptoms among racial/ethnic groups.

The strength of the study is the nationally representative sample used. Moreover, to the best of our knowledge, this is the first population-based study to assess the potential predictors of asthma in each of the six racial/ethnic groups. By pursuing this method, we were able to identify race-specific predictors of asthma prevalence. There are also limitations to our study. One limitation is that our findings were circumscribed by the predictive factors available in the BRFSS 2009 and 2010 data. Because of the absence of data, we were regrettably unable to examine the association between asthma prevalence and other known predictors (e.g., eczema, allergic rhinitis, a positive family history of asthma, mold, pollens, house dust mites, cockroaches, rodents, animal allergens, and ETS, and other air pollutants). The same is true for GERD, chronic sinus disease, and viral and bacterial infections (6, 8, 12). In addition, because of the cross-sectional nature of the survey, we could not generally determine the temporal sequence or causality. For example, it is not clear whether physical activity improves asthma symptoms, so that people with asthma report no longer having asthma or people with asthma avoid leisure time physical activity to prevent experiencing asthma episodes. Finally, the findings cannot be generalized to children because of the age cut-off of BRFSS data.

Conclusion

Our findings show that predictors of asthma differed by race and ethnicity. As in the results for whites and blacks, all selected potential factors (sex, age, education, income, obesity, smoking, physical activity, and health insurance status) were significant predictors of asthma prevalence in the overall adult population. Fewer factors were significant predictors of asthma for the other four racial/ethnic groups (Hispanics, AI/AN, Asian, and other race). In addition to lacking sufficient statistical power because of the small sample size for some racial/ethnic groups, differences by race/ethnicity in the predictive ability of some variables may have contributed to observed differences in asthma prevalence among racial/ethnic groups. Further studies are warranted to determine the underlying mechanisms and the persistence of racial/ethnic differences in predictive factors for asthma. Identifying race/ethnicity-specific modifiable predictors of asthma prevalence can be important in developing targeted interventions to reduce the health and economic impact of asthma among the disproportionately affected segments of the United States population.

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Table 1

Characteristics of adult survey respondents—2009–2010 Behavioral Risk Factor Surveillance System data.

	Total	Characteristics of survey respondents	Current asthma prevalence	
	Sample size ^a	% (95% CI)	% (95% CI)	aPR (95% CI) ^b
Total	869,519	100 (0–0)	8.6 (8.4–8.8)	
Sex			$p < .0001^c$	
Male	329,080	48.7 (48.5–48.9)	6.4 (6.3–6.6)	1.0 (reference)
Female	540,439	51.3 (51.1–51.5)	10.5 (10.3–10.7)	1.6 (1.5–1.6)
Age, year range			$p < .0001$	
18–34	95,841	28.2 (28.0–28.5)	9.3 (9.0–9.6)	1.0 (reference)
35–44	116,615	20.2 (20.1–20.4)	7.8 (7.6–8.1)	0.8 (0.8–0.9)
45–54	170,300	19.5 (19.3–19.6)	8.4 (8.2–8.7)	0.8 (0.8–0.9)
55–64	194,791	14.7 (14.6–14.8)	9.0 (8.8–9.2)	0.8 (0.8–0.9)
65+	284,209	17.4 (17.2–17.5)	7.8 (7.6–7.9)	0.7 (0.6–0.7)
Race(non-Hispanic)/ Ethnicity			$p < .0001$	
White	690,022	69.2 (69.0–69.4)	8.6 (8.5–8.8)	1.0 (reference)
Black	68,024	10.2 (10.0–10.3)	10.0 (9.6–10.5)	1.0 (0.9–1.0)
AI/AN ^d	11,961	1.1 (1.0–1.1)	13.0 (11.7–14.5)	1.3 (1.1–1.5)
Asian/Pacific Islander	15,899	3.8 (3.7–3.9)	4.8 (4.2–5.5)	0.7 (0.6–0.8)
Hispanic	53,732	13.6 (13.4–13.8)	6.7 (6.3–7.1)	0.7 (0.7–0.8)
Other race	18,973	2.2 (2.1–2.3)	13.5 (12.5–14.5)	1.4 (1.3–1.5)
Education level			$p < .0001$	
High school (HS) graduate or less	340,602	38.4 (38.2–38.6)	9.1 (8.9–9.3)	1.0 (1.0–1.0)
Some college	232,036	26.3 (26.1–26.5)	9.3 (9.1–9.6)	1.1 (1.01–1.1)
College 4 years or more	293,834	35.3 (35.1–35.5)	7.3 (7.1–7.5)	1.0 (reference)
Household income			$p < .0001$	
<\$15,000	86,389	10.4 (10.2–10.5)	13.3 (12.8–13.8)	1.9 (1.8–2.0)
\$15,000–\$24,999	133,940	15.8 (15.6–16.0)	10.2 (9.9–10.6)	1.5 (1.4–1.6)
\$25,000–\$49,999	205,802	24.6 (24.4–24.8)	8.1 (7.9–8.4)	1.1 (1.1–1.2)
\$50,000–\$74,999	120,544	16.0 (15.9–16.2)	7.7 (7.4–8.0)	1.1 (1.0–1.1)
\$75,000	202,340	33.2 (33.9–33.4)	6.8 (6.6–7.0)	1.0 (reference)
Body Mass Index (BMI)			$p < .0001$	
Obese	234,550	27.6 (27.4–27.8)	11.6 (11.4–11.9)	1.5 (1.5–1.6)
Non-obese	594,395	72.4 (72.2–72.6)	7.3 (7.2–7.4)	1.0 (reference)
Smoking status			$p < .0001$	
Current smoker	139,086	17.6 (17.4–17.8)	10.5 (10.2–10.9)	1.2 (1.2–1.3)
Former smoker	263,614	24.9 (24.7–25.1)	8.8 (8.6–9.0)	1.2 (1.1–1.2)
Non-smoker	461,190	57.5 (57.3–57.7)	7.8 (7.7–8.0)	1.0 (reference)
Physical activity			$p < .0001$	
Active	631,847	75.7 (75.5–75.9)	7.8 (7.7–7.9)	0.8 (0.8–0.9)

	Total	Characteristics of survey respondents	Current asthma prevalence	
	Sample size ^a	% (95% CI)	% (95% CI)	aPR (95% CI) ^b
Inactive	236,492	24.3 (24.1–24.5)	10.7 (10.5–11.0)	1.0 (reference)
Health insurance			$p < .0001$	
Yes	776,029	84.7 (84.5–84.8)	8.6 (8.5–8.8)	1.3 (1.2–1.4)
No	91,238	15.3 (15.2–15.5)	7.8 (7.5–8.2)	1.0 (reference)

Notes:

^a Sample size (unweighted) for the corresponding subpopulations.

^b Prevalence rate ratio (95% confidence interval) adjusted for age, sex, race, ethnicity, education, income, obesity, smoking, physical activity, and health insurance.

^c P -values for the chi-square test for independence to determine whether there is a significant relationship between two categorical variables.

^d American Indian/ Alaskan Native.

Table 2

Current asthma prevalence and adjusted prevalence rate ratios by selected predictors among racial and ethnic adult populations—2009–2010 Behavioral Risk Factor Surveillance System data—white, black, Hispanic.

	White (<i>n</i> = 688,173)		Black (<i>n</i> = 67,893)		Hispanic (<i>n</i> = 53,624)	
	Current asthma prevalence % (95% CI)	Prevalence ratio aPR (95% CI) ^a	Current asthma prevalence % (95% CI)	Prevalence ratio aPR (95% CI) ^a	Current asthma prevalence % (95% CI)	Prevalence ratio aPR (95% CI) ^a
Sex	<i>p</i> < .0001 ^b		<i>p</i> < .0001		<i>p</i> < .0001	
Male	6.6 (6.4–6.8)	1.0 (reference)	7.2 (6.5–8.0)	1.0 (reference)	5.0 (4.5–5.7)	1.0 (reference)
Female	10.6 (10.4–10.8)	1.6 (1.5–1.7)	12.3 (11.7–12.9)	1.6 (1.5–1.9)	8.4 (7.9–8.9)	1.7 (1.5–2.0)
Age, year range	<i>p</i> < .0001		<i>p</i> < .0001		<i>p</i> = .0327	
18–34	10.0 (9.6–10.4)	1.0 (reference)	11.5 (10.4–12.7)	1.0 (reference)	6.6 (6.0–7.4)	1.0 (reference)
35–44	8.2 (7.9–8.5)	0.8 (0.8–0.9)	9.2 (8.3–10.2)	0.8 (0.7–0.9)	6.1 (5.4–6.9)	0.9 (0.7–1.0)
45–54	8.5 (8.2–8.7)	0.8 (0.8–0.9)	9.2 (8.4–9.9)	0.7 (0.6–0.8)	6.8 (6.1–7.6)	0.9 (0.8–1.1)
55–64	8.7 (8.5–8.9)	0.8 (0.8–0.8)	10.7 (9.8–11.7)	0.8 (0.7–1.0)	8.0 (7.1–9.1)	1.0 (0.9–1.2)
65+	7.6 (7.5–7.8)	0.6 (0.6–0.7)	8.4 (7.7–9.2)	0.6 (0.5–0.7)	7.5 (6.6–8.4)	0.8 (0.7–1.0)
Education level	<i>p</i> < .0001		<i>p</i> < .0001		<i>p</i> = .0001	
High school or less	9.5 (9.3–9.8)	1.0 (0.9–1.0)	11.2 (10.4–12.0)	1.2 (1.03–1.3)	6.2 (5.7–6.7)	1.0 (0.9–1.2)
Some college	9.2 (8.9–9.4)	1.0 (1.0–1.1)	10.1 (9.3–11.0)	1.1 (1.0–1.3)	8.5 (7.6–9.5)	1.3 (1.1–1.5)
College 4+ years	7.5 (7.3–7.7)	1.0 (reference)	7.9 (7.2–8.7)	1.0 (reference)	6.5 (5.7–7.4)	1.0 (reference)
Household income	<i>p</i> < .0001		<i>p</i> < .0001		<i>p</i> = .0049	
<\$15,000	16.2 (15.5–16.9)	2.1 (2.0–2.3)	13.8 (12.5–15.2)	1.5 (1.2–1.9)	7.7 (6.8–8.6)	1.3 (1.1–1.7)
\$15,000–\$24,999	11.2 (10.8–11.7)	1.6 (1.5–1.7)	12.3 (11.2–13.5)	1.4 (1.2–1.7)	6.2 (5.4–7.1)	1.0 (0.8–1.3)
\$25,000–\$49,999	8.5 (8.3–8.8)	1.2 (1.1–1.2)	8.5 (7.7–9.4)	1.0 (0.8–1.2)	5.7 (5.1–6.5)	0.9 (0.7–1.1)
\$50,000–\$74,999	7.6 (7.3–7.9)	1.1 (1.0–1.1)	8.7 (7.4–10.2)	1.1 (0.9–1.3)	8.2 (6.9–9.7)	1.1 (0.9–1.5)
\$75,000	6.9 (6.7–7.1)	1.0 (reference)	7.1 (6.1–8.3)	1.0 (reference)	6.8 (5.9–8.0)	1.0 (reference)
Body mass index	<i>p</i> < .0001		<i>p</i> < .0001		<i>p</i> < .0001	
Obese	11.8 (11.5–12.1)	1.5 (1.5–1.6)	12.6 (11.8–13.4)	1.4 (1.3–1.6)	8.9 (8.2–9.8)	1.5 (1.3–1.7)
Non-obese	7.4 (7.3–7.6)	1.0 (reference)	8.2 (7.6–8.9)	1.0 (reference)	6.0 (5.5–6.5)	1.0 (reference)
Smoking status	<i>p</i> < .0001		<i>p</i> = .0027		<i>p</i> < .0001	
Current smoker	10.4 (10.0–10.7)	1.2 (1.1–1.2)	11.7 (10.6–12.9)	1.2 (1.1–1.4)	8.9 (7.8–10.1)	1.6 (1.3–1.9)
Former smoker	8.7 (8.5–8.9)	1.1 (1.1–1.2)	10.1 (9.3–11.0)	1.2 (1.1–1.3)	7.9 (7.0–8.9)	1.4 (1.2–1.6)
Non-smoker	8.1 (7.9–8.3)	1.0 (reference)	9.5 (8.9–10.1)	1.0 (reference)	6.0 (5.6–6.5)	1.0 (reference)
Physical activity	<i>p</i> < .0001		<i>p</i> < .0001		<i>p</i> = .0460	
Active	7.9 (7.7–8.0)	0.8 (0.8–0.9)	9.0 (8.5–9.6)	0.9 (0.8–0.95)	6.5 (6.0–6.9)	0.9 (0.8–1.0)
Inactive	11.2 (10.9–11.5)	1.0 (reference)	12.1 (11.3–13.0)	1.0 (reference)	7.3 (6.6–8.1)	1.0 (reference)
Health insurance	<i>p</i> = .0019		<i>p</i> = .4859		<i>p</i> < .0001	
Yes	8.5 (8.4–8.7)	1.2 (1.2–1.3)	10.1 (9.6–10.6)	1.2 (1.02–1.4)	7.9 (7.5–8.5)	1.7 (1.5–2.1)
No	9.4 (8.9–9.9)	1.0 (reference)	9.7 (8.6–10.9)	1.0 (reference)	4.3 (3.7–5.0)	1.0 (reference)

Notes:

^aPrevalence rate ratio (95% confidence interval) adjusted for age, sex, education, income, obesity, smoking, physical activity, and health insurance.

^b *P*-values for the chi-square test for independence to determine whether there is a significant relationship between two categorical variables.

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Table 3

Current asthma prevalence and adjusted prevalence rate ratios by selected predictors among racial and ethnic adult populations—2009–2010 Behavioral Risk Factor Surveillance System data—American Indian/Alaska Native (AI/AN), Asian/Pacific Islander, Other race.

	AI/AN ^a (n = 11,916)		Asian/Pacific Islander (n = 15,840)		Other race (n = 18,895)	
	Current asthma prevalence % (95% CI)	Prevalence ratio aPR (95%CI) ^b	Current asthma prevalence % (95% CI)	Prevalence ratio aPR (95%CI)	Current asthma prevalence % (95% CI)	Prevalence ratio aPR (95% CI)
Sex	$p^c < .0001$		$p = .5748$		$p < .0001$	
Male	9.5 (7.8–11.5)	1.0 (reference)	4.7 (3.8–5.7)	1.0 (reference)	10.7 (9.4–12.2)	1.0 (reference)
Female	17.4 (15.4–19.6)	1.7 (1.4–2.2)	5.0 (4.2–5.9)	1.1 (0.8–1.4)	16.5 (15.2–17.8)	1.4 (1.2–1.7)
Age, year range	$p = .0538$		$p = .0009$		$p = .0087$	
18–34	11.6 (9.0–14.8)	1.0 (reference)	4.5 (3.4–6.0)	1.0 (reference)	13.7 (11.7–15.9)	1.0 (reference)
35–44	12.9 (9.6–17.2)	1.1 (0.7–1.6)	3.4 (2.6–4.4)	0.8 (0.5–1.2)	13.5 (11.5–16.0)	1.0 (0.8–1.2)
45–54	14.5 (12.0–17.4)	1.2 (0.9–1.6)	6.1 (4.8–7.8)	1.4 (1.0–2.0)	15.0 (13.1–17.1)	1.0 (0.8–1.3)
55–64	16.5 (13.6–19.9)	1.3 (1.0–1.8)	6.6 (5.0–8.6)	1.4 (1.0–2.1)	13.3 (11.7–15.0)	0.9 (0.7–1.1)
65+	11.1 (8.9–13.7)	0.9 (0.6–1.2)	6.1 (4.7–7.8)	1.3 (0.9–1.8)	10.8 (9.5–12.3)	0.6 (0.5–0.8)
Education level	$p = .0829$		$p = .1567$		$p = .0003$	
High school or less	14.4 (12.4–16.7)	1.1 (0.8–1.5)	5.0 (3.7–6.7)	1.1 (0.8–1.6)	14.4 (12.8–16.1)	1.0 (0.9–1.2)
Some college	12.4 (10.0–15.3)	1.0 (0.7–1.4)	6.2 (4.5–8.5)	1.4 (1.0–2.0)	15.1 (13.3–17.2)	1.2 (0.9–1.4)
College 4+ years	10.6 (8.3–13.5)	1.0 (reference)	4.3 (3.6–5.0)	1.0 (reference)	10.7 (9.2–12.3)	1.0 (reference)
Household income	$p = .0001$		$p = .0998$		$p < .0001$	
<\$15,000	17.9 (15.0–21.3)	2.0 (1.2–3.2)	8.0 (5.4–11.7)	1.9 (1.2–2.9)	23.8 (20.4–27.5)	2.5 (1.8–3.3)
\$15,000–\$24,999	15.5 (12.6–19.0)	1.7 (1.0–2.9)	4.2 (2.8–6.3)	0.9 (0.6–1.5)	16.5 (14.1–19.4)	1.7 (1.3–2.4)
\$25,000–\$49,999	11.9 (9.3–15.1)	1.5 (0.9–2.4)	3.8 (2.8–5.3)	0.8 (0.5–1.2)	12.8 (11.0–14.8)	1.3 (1.0–1.8)
\$50,000–\$74,999	9.8 (6.8–14.0)	1.4 (0.8–2.3)	6.4 (4.5–8.9)	1.3 (0.9–2.0)	9.9 (7.8–12.5)	1.1 (0.8–1.6)
\$75,000	7.8 (5.3–11.3)	1.0 (reference)	4.6 (3.7–5.7)	1.0 (reference)	9.0 (7.2–11.2)	1.0 (reference)
Body mass index	$p = .0566$		$p = .0002$		$p < .0001$	
Obese	15.2 (12.9–17.7)	1.2 (1.0–1.5)	9.2 (7.1–11.9)	2.1 (1.5–2.8)	18.8 (16.9–20.8)	1.5 (1.3–1.8)
Non-obese	12.2 (10.5–14.2)	1.0 (reference)	4.4 (3.7–5.1)	1.0 (reference)	11.1 (10.0–12.4)	1.0 (reference)
Smoking status	$p = .0135$		$p = .4956$		$p = .0111$	
Current smoker	15.9 (13.2–19.0)	1.3 (1.01–1.8)	5.1 (3.2–7.9)	1.1 (0.7–1.7)	16.3 (14.2–18.6)	1.2 (1.0–1.4)
Former smoker	13.1 (11.0–15.6)	1.3 (1.0–1.7)	5.9 (4.3–7.9)	1.1 (0.8–1.6)	12.5 (10.8–14.6)	1.1 (0.9–1.3)
Non-smoker	10.6 (8.7–12.8)	1.0 (reference)	4.7 (4.0–5.5)	1.0 (reference)	12.5 (11.2–13.8)	1.0 (reference)
Physical activity	$p < .0001$		$p = .8934$		$p < .0001$	
Active	10.9 (9.5–12.4)	0.7 (0.6–0.9)	4.8 (4.2–5.6)	1.2 (0.9–1.6)	11.9 (10.8–13.1)	0.8 (0.7–0.9)
Inactive	18.5 (15.5–22.0)	1.0 (reference)	4.7 (3.6–6.2)	1.0 (reference)	18.2 (16.3–20.4)	1.0 (reference)
Health insurance	$p = .6644$		$p = .0003$		$p = .9301$	
Yes	12.9 (11.5–14.4)	1.0 (0.8–1.4)	5.2 (4.5–6.0)	2.4 (1.4–4.1)	13.5 (12.5–14.6)	1.2 (1.0–1.6)
No	13.7 (10.5–17.8)	1.0 (reference)	2.4 (1.4–4.1)	1.0 (reference)	13.4 (11.0–16.1)	1.0 (reference)

Notes:

^a American Indian/ Alaska Native.

^b Prevalence rate ratio (95% confidence interval) adjusted for age, sex, education, income, obesity, smoking, physical activity, and health insurance.

^c P -values for the χ^2 test for independence to determine whether there is a significant relationship between two categorical variables.